Helwan University
Faculty of Engineering – Mataria

A Course on

Energy Conservation

Combustion Performance

Ass.Prof.. Adel Hussien

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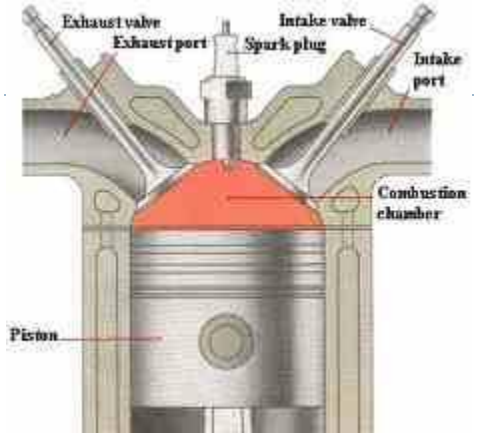

Exhaust valve
Exhaust port
Spark plug
Intake valve
Intake port
Combustion chamber
Piston


O2N2
Fuel
COMBUSTION
Ignition

Introduction

- Fuel stores energy in its chemical structure.
- The most efficient method for releasing energy from fossil fuels is by burning them in oxygen (combustion).
- Fuel reacts with oxygen and releases energy as heat.
- Different types of fuel are utilized.

Fuel Types

Fuel Types

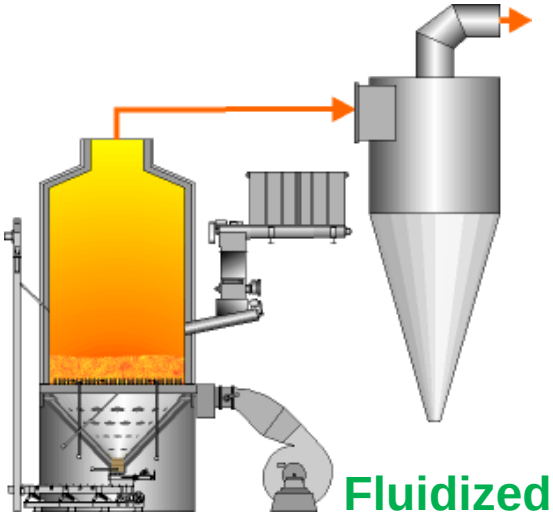
- **Solid Fuel**

Mine

Rocks

Transportation

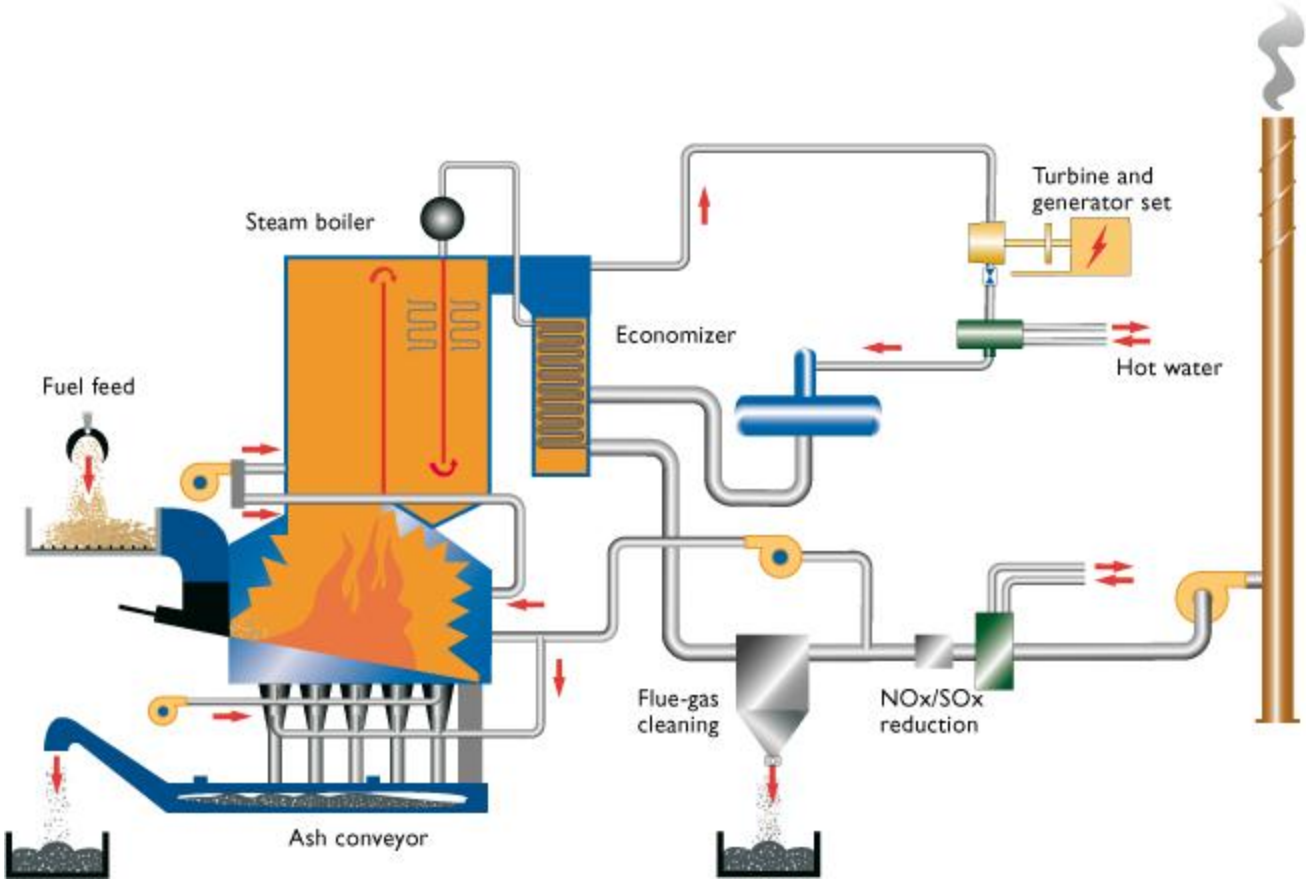
Surface combustion



Fluidized bed

Fuel Types

- **Solid Fuel**

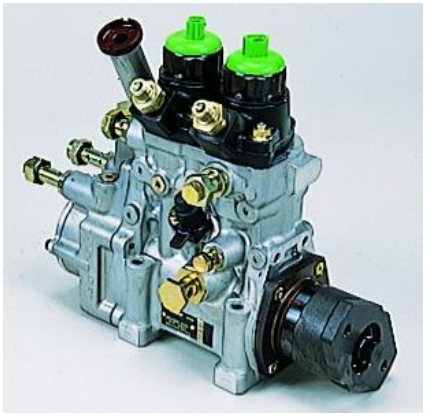


Fuel Types

- Liquid Fuel

Pressure gauge

Filter



Pump

Effect of pressure on atomization

Combustion

Fuel Types

- **Gaseous Fuel**

Natural gas line

Supply system

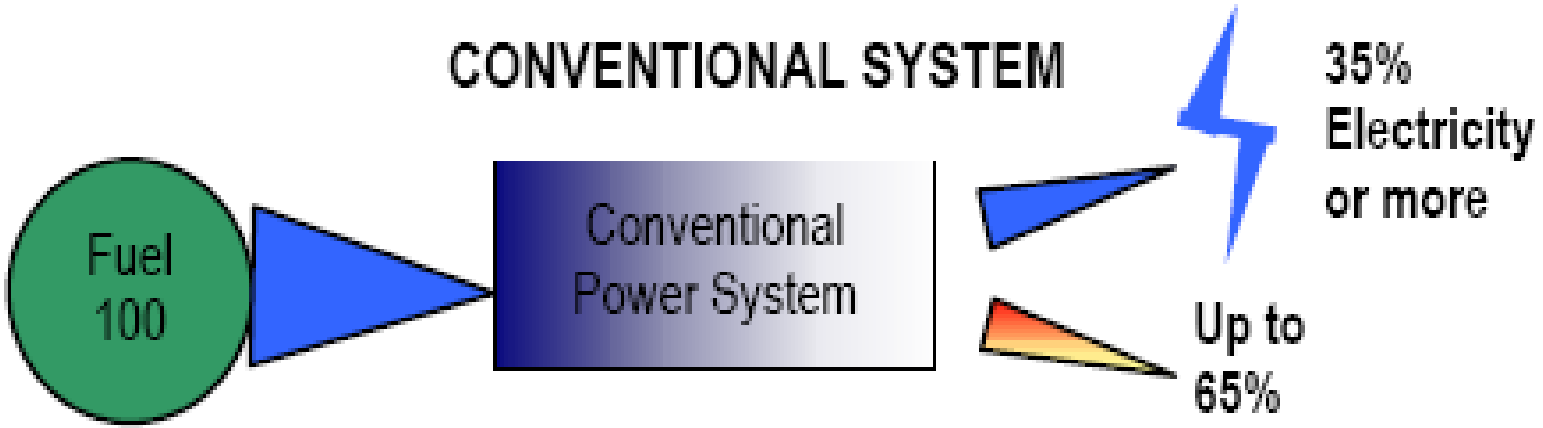
Car using NG

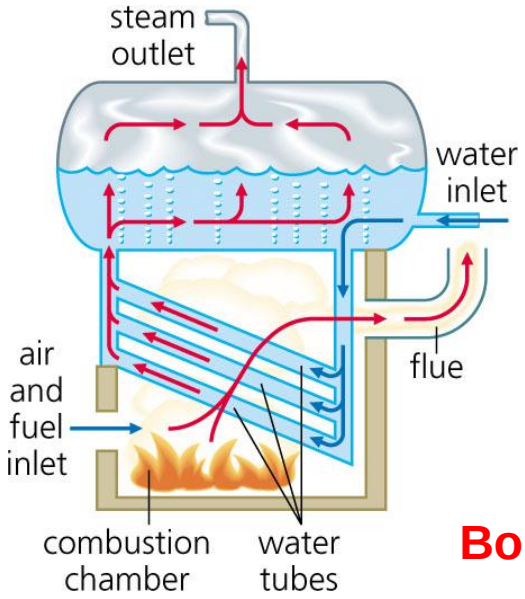
LPG bottles

Domestic burner

Danger

Power Generation





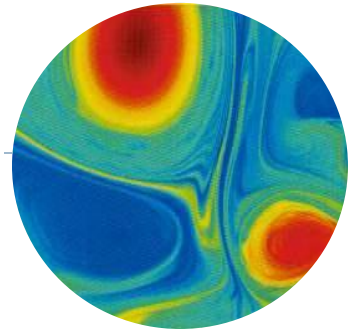
Boiler

Engine-generator

Combustion Temperature

- Heating value
- Air to fuel ratio(λ)
- Air and fuel inlet temperatures
- Others, ----------

Combustion Requirements



1- Fuel (Solid – Liquid – Gaseous)

2- Air (Stoichiometric – Lean – Rich)

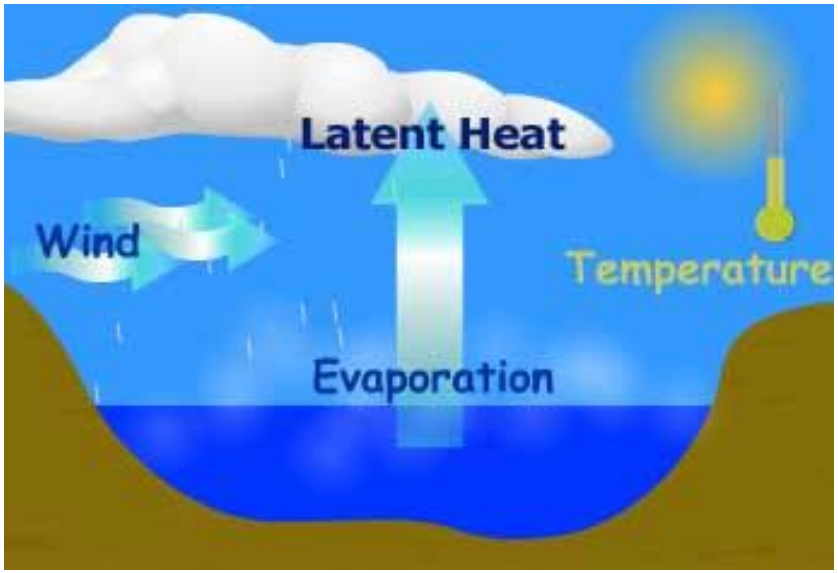
3- Temperature (Ignition)

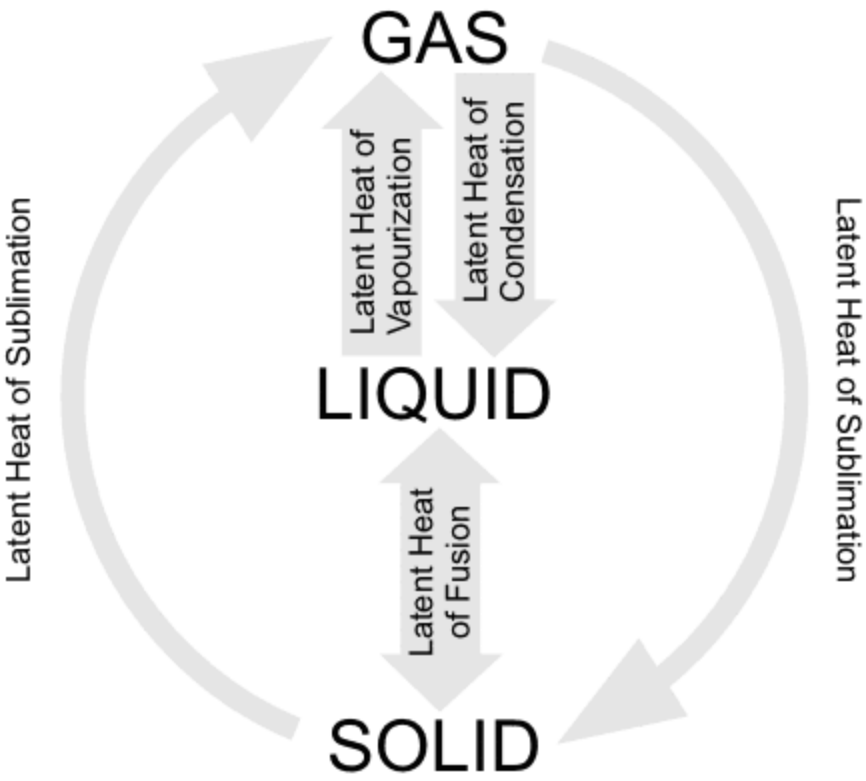
4- Turbulence (Mixing – Swirl)

5- Time (Complete combustion)

Heating Value

Latent Heat





Heating Value

1- Higher Heating Value CV_h

2- Lower Heating Value CV_L

$$CV_h - CV_L = m_w \times \text{Latent heat}$$

Exhaust

Emission

Exhaust

Emission

1- **Carbon monoxide** (air – time – mixing – etc.)

2- **Sulfur oxides** (sulfur content)

3- **Nitrogen oxides** (temperature + oxygen)

4- **Carbon dioxide** (global warming)

Exhaust

Temperature

1- System efficiency (heat losses)

2- Due point (sulfuric acid)

Factors Affecting Combustion Efficiency

1- Unburned fuel (UHC)

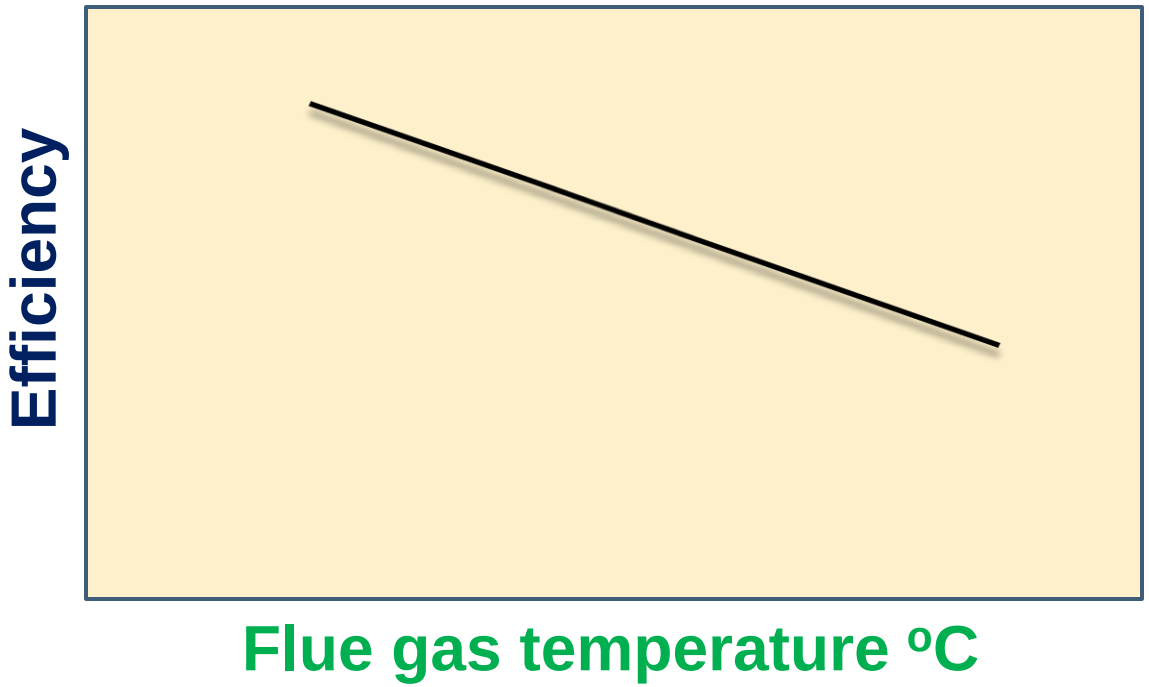
2- Heat losses (Q_{exh} – Q_{sur} – etc.)

3- Flue gases (temp – due point)

4- Air preheating

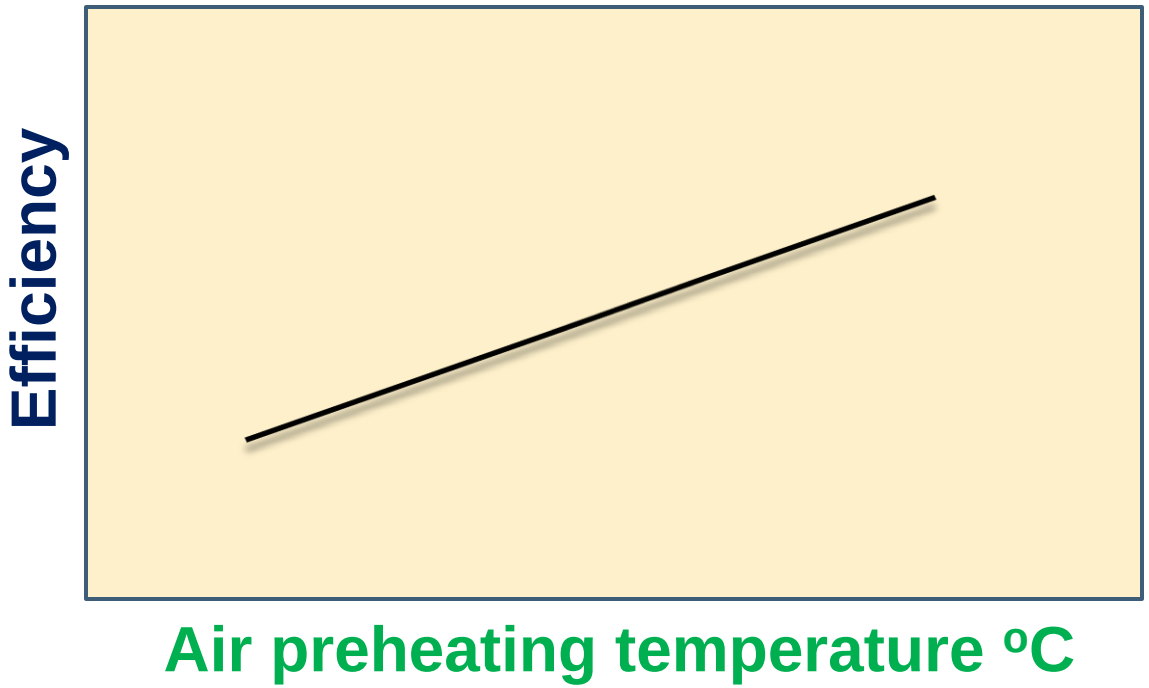
Factors Affecting Combustion Efficiency

Flue gases (temp – due point)



Factors Affecting Combustion Efficiency

Air preheating (temperature)



Importance of Efficiency

1- Population (increase)

2- Fossil fuel (decrease)

3- Industrial (economy)

Thank you

Any questions?